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Comparative morpho-anatomy of *Urospatha* Schott inflorescence (Araceae) occurring in the State of Amapá, Brazil

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ABSTRACT

The genus *Urospatha* Schott, an aquatic and perennial herb occurring in "várzea" and "igapó" areas. Describe the inflorescence morpho-anatomy of the species found in the state of Amapá, to identify the present types of secretory structures and to verify the chemical nature of the secretion. Adult and fertile *Urospatha* specimens were collected in the Bailique Archipelago; in the municipalities of Calçoene; Mazagão; Porto Grande and Macapá. There were performed morpho-anatomical studies, using scanning electron microscopy techniques and also histochemical tests. *Urospatha* species present terminal inflorescence with flowering throughout the whole year; the spadix has hermaphrodite, tetramerous flowers. The tepals have uniseriate and heterodimensional epidermis, with thick-walled cells with thin and striated cuticle, secretory papillae and stomata. The androecium in adaxial and abaxial regions and right below epidermis occurs in parenchymal cells, and in lower regions occurs the presence of idioblasts carriers of raphides and druses that are more typical in the region close to the anthers. The ovary has/ an uniseriate epidermis with two or three anatropous ovules. The stigma has simple epidermis, papillose and parenchyma with raphides idioblasts. In the adaxial region of the spathe occurs uniseriate epidermis with heterodimensional cells with lignified walls and thin cuticle, and uniseriate hypodermis. The peduncle presents an uniseriate epidermis with lignified walls, thin cuticle, lenticels, stomata, and collenchyma just below the epidermis, with collateral vascular bundless and aerenchyma. The results of this work, especially the morphological and anatomical data, cannot differentiate *Urospatha* species found in the state of Amapá, because they present the same morpho-anatomical pattern for their floral structure.

Keywords: Araceae; anatomy; inflorescence; morphology; *Urospatha*.

Morfoanatomia comparativa do sistema reprodutivo de *Urospatha* Schott (Araceae) ocorrente no Estado do Amapá, Brasil

RESUMO

O gênero *Urospatha* Schott é uma erva aquática e perene que ocorre nas áreas de "várzea" e "igapó". O trabalho descreve a morfoanatomia da inflorescência das espécies encontradas no estado do Amapá, identifica os tipos atuais de estruturas secretoras e verifica a natureza química da secreção. Amostras de *Urospatha* adultas e férteis foram coletadas no Arquipélago de Bailique; nos municípios de Calçoene; Mazagão; Porto Grande e Macapá. Foram realizados estudos morfoanatômicos, utilizando técnicas de microscopia eletrônica de varredura e também testes histoquímicos. As espécies de *Urospatha* apresentam inflorescência terminal com floração durante todo o ano; a espadice tem flores hermafroditas e tetrâmeras. Os tépals têm epiderme unisseriada e heterodimensional, com células de paredes espessas, com cutícula fina e estriada, papilas secretórias e estômatos. O androceu nas regiões adaxial e abaxial e logo abaixo da epiderme ocorre nas células parenquimatosas, e nas regiões inferiores ocorre a presença de idiosblastos portadores de ráfides e drusas mais típicos da região próxima às anteras. O ovário tem uma epiderme unisseriada com dois ou três óvulos anátropos. O estigma tem epiderme simples, papilose e parênquima com ráfides idiosblastos. Na região adaxial da espata ocorre epiderme unisseriada com células heterodimensionais, com paredes lignificadas e cutícula fina e hipoderme unisseriada. O pedúnculo apresenta uma epiderme unisseriada com paredes lignificadas, cutícula fina, lenticelas, estômatos e colênquima logo abaixo da epiderme, com bundless vascular colateral e aerênquima. Os resultados deste trabalho, principalmente os dados morfológicos e anatômicos, não conseguem diferenciar as espécies de *Urospatha* encontradas no estado do Amapá, pois apresentam o mesmo padrão morfo-anatômico para sua estrutura floral.

Palavras-chave: Araceae, anatomia, inflorescência, morfologia, *Urospatha*.

Introduction

Araceae Juss. is subcosmopolitan and covers around 110 genera with approximately 3500 species, being most of them tropical and subtropical and, some genera, endemic. In South America, it is represented by 38 genera and around two-thirds of the total of species (MAYO et al., 1997). In Brazil, it is distributed in all phytogeographical domains and preliminary data point the existence of 35 genera totaling 458 species, from which 286 are endemic (COELHO et al., 2000). Its species present a high habit diversity and a great variety in leaves shapes, demonstrating a phenotypic plasticity mainly in the early stages of development, therefore constituting a complex group in terms of life and ecology (CROAT, 1979; MAYO et al., 1997; SOARES; MAYO, 1999). The habit ranges from herbs, small to giant, epiphytes, hemiepiphytes, geophytes, lithophytes, heliophytes, rarely floating or submerged aquatic; they present climbing, arborescent, erect, creeping or underground stem. The large majority of the species prefer humid environments, such as rain forests and swamps, or to grow near running water (MAYO et al., 1997, SOARES; MAYO, 1999).

The species from this family represent a taxonomic group of considerable economic importance, with some species being

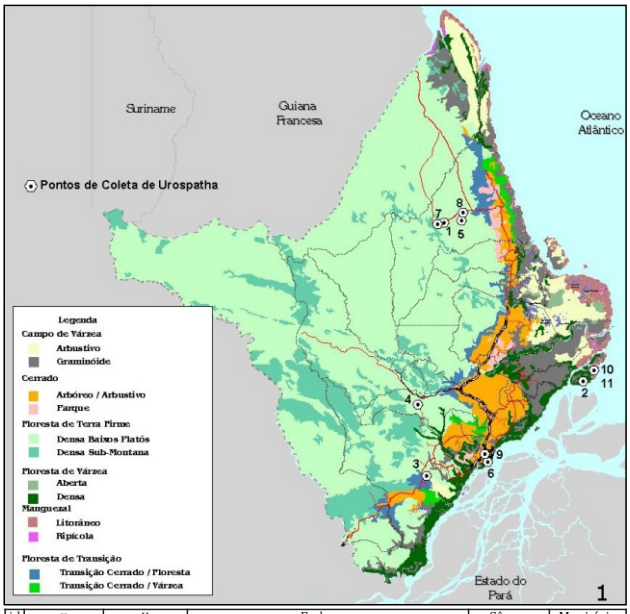
conspicuous for being used for medicinal, edible, fibrous, and, mainly, ornamental purposes, due to the beauty of its foliage (CROAT, 1994; MAYO et al., 1997).

Urospatha Schott, it belongs to the Lasioideae subfamily is popularly known as "Taja-cobra"; it has approximately 25 species and three (CALAZANS, 2019). They have underground stem, with horizontal development, monopodial growth, in which the branches are born from the first internodes, with ornamental foliage (TOSTES; LINS, 1998). They occur in many areas with acid sandy or clay soils and are abundant in lakes, swamps and streams. They are grown by rhizome spreading and also by seed multiplication (POOT; POOT, 2000). This genus presents a great diversity of synonyms, as a result of the large morphological variability degree of its leaves, and taxonomic information on Brazilian species from *Urospatha* genus are still superficial, which complicates its identification – mainly due to the little amount of collections available, field information and scarce biography. Intensive field works are essential for an appropriate understanding of the *Urospatha* genus.

In this context, morpho-anatomical studies on the inflorescence of two *Urospatha* species will be able to provide basis to a correct limitation with the description of the morphology and anatomy of the reproductive organs.

Material e Methods

Urospatha adult and fertile specimens were studied, which had been collected in Bailique Archipelago; in the municipalities of Calçoene, Mazagão, Porto Grande e Macapá (Figure 1). The identification of species (numbered 475, 533, 099, 1694) was made by a comparison with herbarium specimens from the Amapaense Herbarium – HAMAB from Botanical Division in Amapá Institute of Scientific and Technological Research – IEPA, being confirmed by Gonçalves, E.



id	x	y	Endereço	Gênero	Município
1	440701.2000	10257917.0000	Estrada do Lourenço	*Urospatha*	Calçoene
2	592662.8000	10084442.0000	Arquipélago do Bailique, Ilha do Curuá	*Urospatha*	Macapá
3	422105.6000	9981576.9000	Estrada de Macapá - Jarí/BR-156	*Urospatha*	Mazagão
4	412588.1000	10059600.0000	Fazenda Boa Esperança / Ramal do Vila Nova	*Urospatha*	Porto Grande
5	459511.0000	10260674.4000	Estrada do Lourenço	*Urospatha*	Calçoene
6	488656.1000	9996469.2000	Lagoa dos Índios	*Urospatha*	Macapá
7	433287.8000	10256077.7000	Fazenda Alto Bonito/Lourenço	*Urospatha*	Calçoene
8	461088.3000	10268964.0000	Fazenda Alto Bonito/Lourenço	*Urospatha*	Calçoene
9	484946.9000	10005373.0000	Igarapé da Fortaleza - margem	*Urospatha*	Macapá
10	604656.3000	10096804.1000	Escola Bosque - Bailique	*Urospatha*	Macapá
11	604656.3000	10096804.1000	Hotel Escola - Bailique	*Urospatha*	Macapá

Figure 1. *Urospatha* collection points in the state of Amapá

For the morpho-anatomical studies, there were shown the following regions: from spathe: proximal, median area (including edge, internerval region e and midrib) and distal; from peduncle: basal, median and apical thirds of the spathe blade (Figure 2).

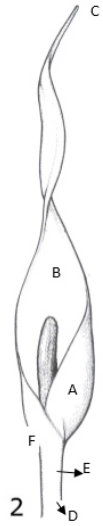


Figure 2. Schematic drawing of a specimen of the studied species, showing the sectioned regions: A) proximal B) median region (including edge, internerval area and midrib) and C) Distal; from the peduncle: D) basal thirds, E) median and F) apical thirds of the spathe blade.

The samples were fixed in F. A. A. (40% formaldehyde, 50% acetic acid and ethyl alcohol 1:1; 18v/v) and 70% alcohol GL (JOHANSEN, 1940). There were made cross and longitudinal sections in a fixed and fresh material with a freehand, with the help of a razor blade in the regions mentioned above, later the clarification of the sections with 20% sodium hypochlorite, washing with distilled water, double coloring with astra blue and alkaline fuchsin (GERLACH, 1977); assembly in glycerined gelatin; observations in Zeiss.

Median regions of the spathe and the spadix were sectioned transversely and longitudinally on a rotary microtome, being fixed for 48 hours in 50% FAA; dehydrated in ascending alcohol series (50%, 70%, 95%, 100%, 2 hours each); to pure acetate, following paraffin immersion; blocks sectioning; blades drying with a drying oven, decreasing series of pure acetate to 50% alcohol, double coloring of sections with Astrablau and 1% Basic Fuchsin , increasing series of 50% alcohol to pure acetate and slide mounting with Canada balsam (JOHANSEM, 1940); observations of the sections and documentation in Zeiss light microscope. The photomicrographs were taken in light microscopes and in different increases and micrometer scale, where they were photographed and enlarged under the same optical conditions used.

For the spadix, studies in Scanning Electron Microscopy were performed, where the samples of the median region were fixed in glutaraldehyde or FAA; dehydration in ascending alcoholic solution series to P.A alcohol; after the critical point, the samples were bonded in an aluminum support; bathed with a 10 mm layer of gold; observed on Leo Scanning Electron Microscope Model 1450 Vp, with microanalysis performed in EDS detector brand Grsham, equipped with Be window, attached to the scanning electron microscope (SILVEIRA; SOUZA, 1989).

For the histochemical tests, sections of fresh material obtained freehand with the help of a razor blade were performed. The cutinized walls, suberized and lipids were analyzed with Sudan IV (JENSEN, 1962); the mucilage was used with aqueous solution of 0.02% ruthenium red (JENSEN, 1962); the starch was visualized with iodinated potassium iodide; saturated picric acid solution for proteins (JOHANSEN 1940); ferric chloride solution for phenolic compounds (JENSEN, 1962); astra blue for cellulose (GERLACH, 1977); 0.05% safranin for lignin (GERLACH, 1977). The sections were temporarily assembled in water or glycerine and photographed on a Zeiss light microscope.

The drawings related to leaves and flowers of *Urospatha* Schott species were prepared with the aid of a camera lucida attached to a Zeiss magnifying glass in different magnifications in micrometer scale. Later, the drawings were put in Nankin ink.

Results

Urospatha spatial and ecological distribution in the state of Amapá.

Urospatha populations are distributed along "várzea" and "igapó" forests, registered in Bailique Archipelago; in the municipalities of Calçoene; Mazagão; Porto Grande and Macapá (Figure 1), which occupies 4.85% of the vegetal coverage in the state of Amapá and approximately 15.46% of the estuarine coast sector (ZEE, 2008). They are aquatic, emergent and perennial herbs, which occur in extensive populations, in sandy or clay soil; in half shade. They form various individuals in different populations, presenting a foliar morphological variability (Figure 3A).

They are open ecosystems, associated with floodplains of rivers and streams of white-water in the Amazon estuary. They are subjected to a daily cycle of flood and ebb tides of fresh water dammed by the tides. Due to flooding, large quantities of sedimentary material are carried to these areas, which gives it a high natural fertility.

The seedlings, almost always, establish away from their origin, due to competition with the maternal population rhizome budding. In environments of higher competition, where succession is in advanced stage, *Urospatha* species are found in small populations or in isolated individuals, presenting a more expanded foliar blade; height around 2.30 cm; less frequent flowering and, consequently, the reproduction is vegetative, where the rhizome part has an underground horizontal development, presenting stem buds, which will origin new individuals in this population (Figure 3B).

In environments with large *Urospatha* populations, the foliar blade is more reduced, the height is around 0.8 cm to 1.20 cm, which suggests individuals with a more frequent flowering and, consequently, asexual reproduction is more frequent. (Figure 3C).

When adults, they can reach until 2.5m high, present sagittate leaves and a very obtuse apex. Some species have variegated sheath (Figure 3B), where the format of the sheets suffers effects in its development, size and thickness with a very elongated peduncle.

Figure 3. Population distribution of *Urospatha* Schott in the state of Amapá: A - *Urospatha* Schott population in várzea soils; B - *U. sagittifolia* (Rudge) Schott individuals in "igapó" area; C - *U. caudata* (Poepp. & Endl.) Schott individuals in "várzea" area.

The studied species according to Engler position (Engler, 1911), present the following taxonomic position:

Family: Araceae
Subfamily: Lasioideae
Tribe: Lasieae
Genus: Urospatha Schott
Species: *U. sagittifolia* (Rudge) Schott
U. caudata (Poepp. & Endl.) Schott
Urospatha sp.

Flowering and flower morphology

Urospatha species flower during the whole year, each individual producing two or three inflorescences per year. There is resin secretion during anthesis. Since the flowering period occurs in the whole year, with a peak in the period with higher rainfall intensity, and lower intensity in the period correspondent to the most dry season, reproduction is mainly vegetative. Fruit dispersion is realized by tides.

Inflorescence is terminal, and its spathe is persistent until fruit ripening, where inferior or basal part of the spathe is more robust or convoluted, while its superior or distal part is more spiraled and less expanded (Figures 4A, B and C).

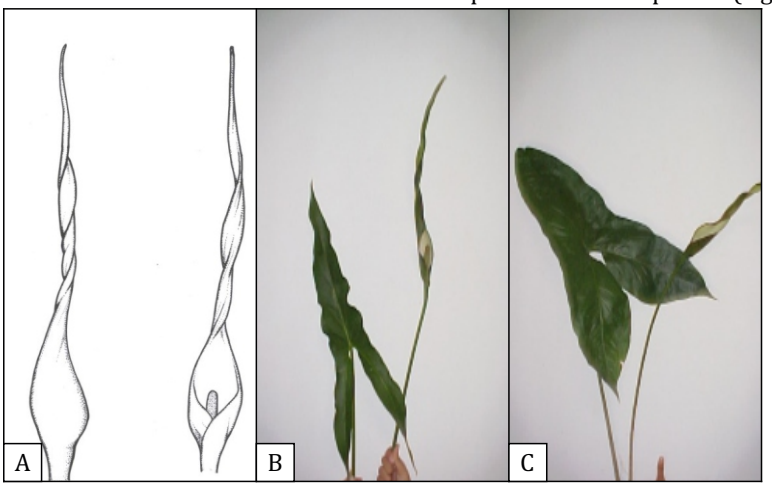


Figure 4. *Urospatha* inflorescence: A - Schematic drawing of an *Urospatha* inflorescence; B - Terminal inflorescence of *U. caudata*; C - Terminal inflorescence of *U. sagittifolia*.

The spadix is constituted by hermaphrodite (Figure 5A), tetramerous (Figure 5B) flowers, distributed uniformly. They are whitish during development and greenish when ripe. The gynoecium has a semi-inferior ovary attached at its base to the axis of the spadix, it is bilocular and/or often unilocular (Figure 5A), presents greenish tepals at maturity and in the style region and in the stigma occurs a fusion. In the androecium it can be observed, through cross-sections, stamens in four around the floral axis in the same spadix (Figure 5B).

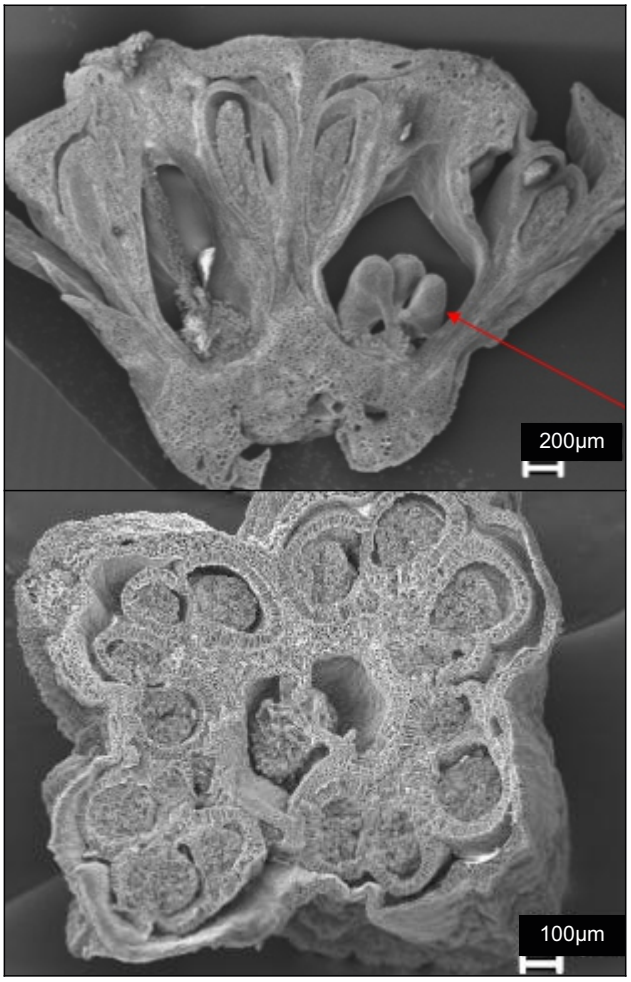


Figure 5. *Urospatha* inflorescence eletromicrography (MEV). A - Longitudinal cut in the spadix, showing the gynoecium with a semi-inferior ovary; B - Cross cut in the spadix, shoowing the androecium with tetramerous stamens.

Inflorescence anatomy

The current study revealed that the reproductive organs of the *Urospatha* studied species present identical anatomic organization. Thus, the illustrations which follow the descriptions refer to any type of *Urospatha* species.

Spadix/Tepals

In cross section, the adaxial region of the tepals show uniseriate and heterodimensional epidermis, with very elongated and thick-walled cells, with thin and striated cuticles, presence of mucilage papillae, chloroplasts, where the stomata are present both in adaxial and abaxial faces (Figure 6). The mesophyll presents parenchymal and collenchymal cells, the rest of the tissue being filled with intercell spaces and numerous idioblasts carriers of raphides and druses, also small mucilage secretory cavities. The epidermis in the abaxial region is uniseriate and heterodimensional, where the walls of periclinal and anticlinal cells are thick, with thin cuticle and absent secretory papillae. (Figure 7).

Androecium

In cross section, the stamens form a tube attached to the basis of the ovary and the tepals and in the apex of this tube there are anthers (Figure 6). In the lower region of the tube, which connects to the axis of the spadix, there are meristematic cells from protodermis, which will origin epidermis, while it is already formed in its superior region. There, the epidermis is uniseriate with cubic format. In adaxial and abaxial regions and right below epidermis occurs parenchymal cells, while in the lower region there are meristematic cells (Figure 7). In the proximal region to the anthers, it is observed the presence of idioblasts carriers of raphides and druses. Mature anthers are tetrasporangiate (Figure 9), with a very elongated epidermis of thin cell wall and cuticle. The anthers in formation are constituted by the precursor layer of the epidermis (Figure 7).

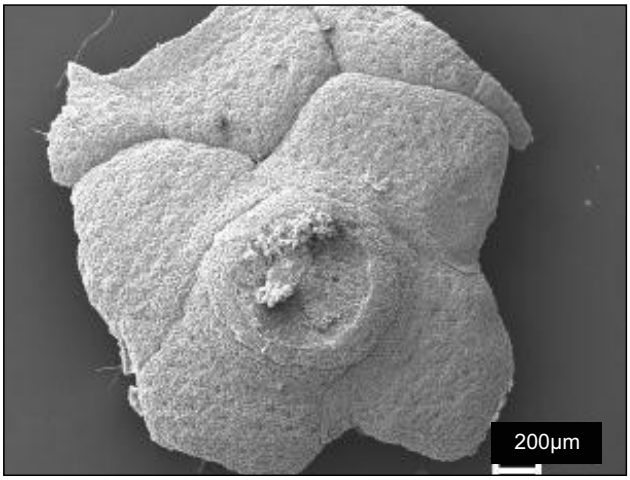


Figura 6. *Urospatha* inflorescence eletromicrography (MEV).Cross section in the spadix, showing the tepals.

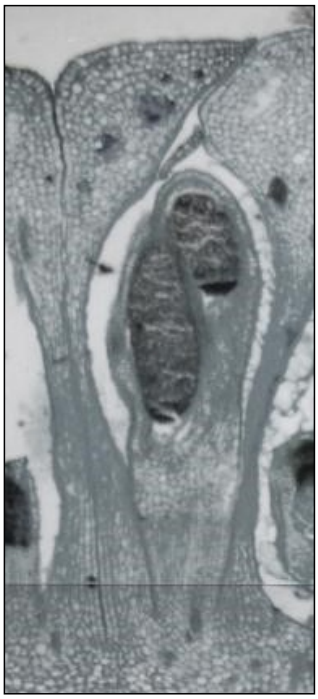


Figura 7. *Urospatha* inflorescence photomicrography. Cross section in the spadix, showing the tepals and the androecium.

Gynoecium

The ovary, in cross section. is unilocular or bilocular; it has its basis attached to the axis of the spadix, axial placentation when the ovary has two locules, and basal when it has only one (Figure 8). The ovary has epidermis with a single layer of cells, where its internal epidermis, still in pre-anthesis, develops meristematic activities. The seminal rudiments (ovules), two or three per locule, still in meristematic activities due to its anticlinal and periclinal divisions, then takes the anatropous form. Mature ovules have several layers of cells between the simple epidermis and the yolk sac (Figure 8).

In the stigma, the epidermis is simple with secretory papillae and parenchyma with many cells of raphides idioblasts. The superior region of the stigma has round shape with numerous mucilage papillae. (Figure 8).

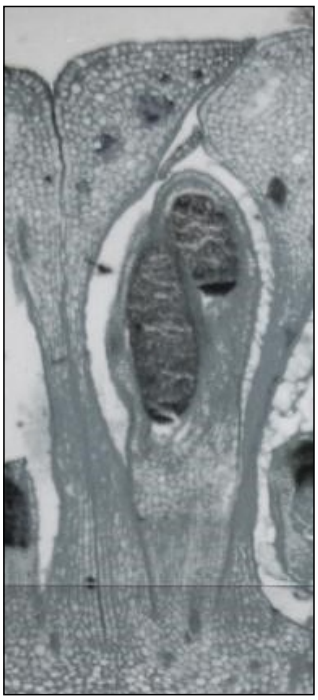


Figura 8. *Urospatha* inflorescence photomicrography. Cross section in the spadix, showing the ovary with mature ovules.

Spathe limb

In cross section of the median region of the midrib, the epidermis is uniseriate, the cells are heterodimensional, with lignified anticlinal and periclinal walls; very thin cuticle, stomata with wide substomatal cavity and well-limited presence of lacunar collenchyma with two to three layers interleaved with raphides idioblasts cells and lipid cells and protein. The lacunar parenchyma has cells with small intercell spaces, forming channels; collateral vascular bundles distributed throughout the tissue. There is aerenchyma in different sizes, which are formed exclusively by schizogenous processes and cells with raphides and druses idioblasts are present in the tissue (Figures 9, 10 and 11). In the edge of the midrib of the spathe, there are many lenticels, cells containing phenolic substances and cellulose. In the abaxial region, the epidermis is uniseriate with tall cells; thin cuticle; collenchyma and the presence of forming mucilage channels. In the proximal and distal regions of the spathe, the anatomic structure is similar to the one observed in the median region (Figure 9).

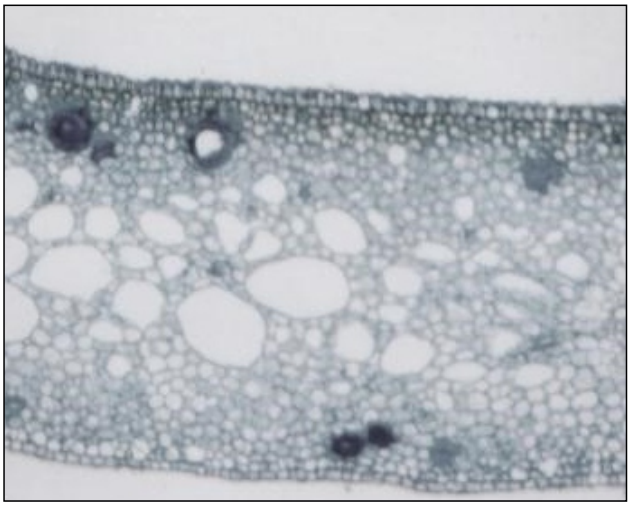


Figure 9. *Urospatha* inflorescence photomicrography. Cross section in the spathe, showing the median region of the midrib.

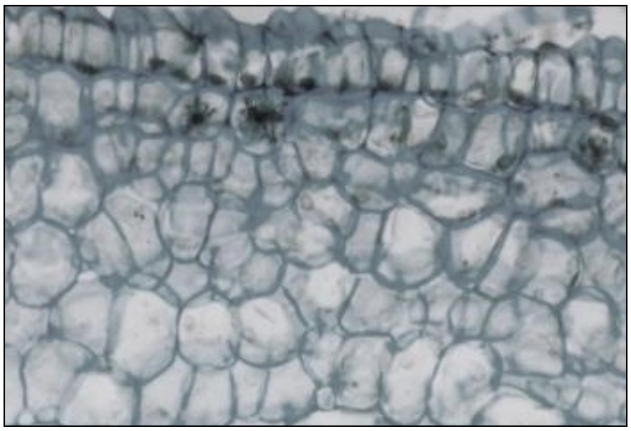


Figure 10. *Urospatha* inflorescence photomicrography. Cross section in the spathe, showing druses idioblasts.

Peduncle

In cross cut in the median region of the peduncle, the epidermis is uniseriate, with lignified anticlinal and periclinal walls; thin cuticle and presence of lenticels, stomata with substomatal cavity, presence of starch grains. Presents a hypodermis, right below the epidermis, simple collateral vascular bundles randomly distributed throughout the tissue, presenting a very reduced phloem and aerenchyma formed by schizogenous processes. Idioblasts containing raphides and druses are abundant in all tissues (Figure 11).

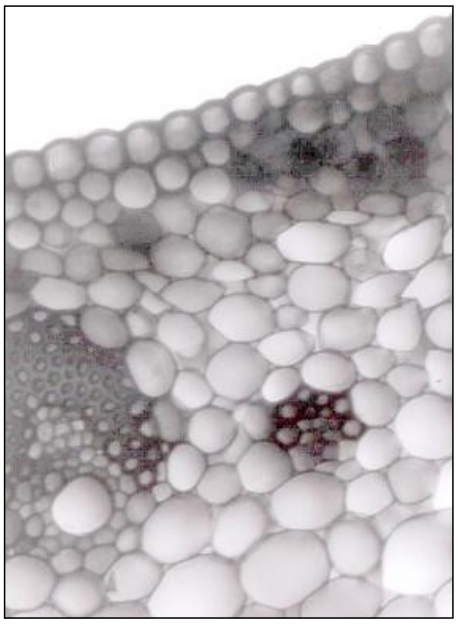


Figura 11. *Urospatha* inflorescence photomicrography. Cross section in the peduncle, showing the median region.

Discussion

Araceae presents inflorescence in spadix shape, composed by numerous bisexual or unisexual flowers, associated to a bract named spathe. The infructescence is usually cylindrical or, sometimes, round. The fruits are tipically suculent berries, although rarely dry, but of red or orange, depending on the genus in question (MAYO et al., 1997). In *Urospatha,* the inflorescence is formed by spathe and spadix, and the first one shows different colors, depending on the species.

Many genera from Araceae family have been reason for studies due to their high vegetative, reproductive, habit, leaves dimorphism, stem metamorphism, roots dimorphism and morphological adaptation diversity (BUNTING, 1968; HINCHEE, 1981; RAY 1987 a,b). Many are the anatomical and morphological adaptations found among várzea macrophytes (BOEGER, 1994; MAXIMOV, 1952); we highlight the studied *Urospatha* species, which represent foliar variation due to its high ecological range in the environment (TOSTES; LINS, 1998).

There is a remarkable variability in the shape and structure of the tissues which compose the reproductive organs. This variability is often related to the function which it develops, and also the environmental conditions influence in the reproductive organs, as we verified in the studied species. According to Coelho (2000), this reproductive variability also occurs in some species from the genus *Philodendron* Schott.

In brazilian species, only one simple terminal inflorescence is produced in the flowering branches from the genus *Philodendron,* subgenus *Pteromischum* (COELHO, 2000)*;* in *Urospatha* there occurs two to three inflorescences per individual per year. *Philodendron* flowers are basically dimerous and trimerous in equal proportions (COELHO, 2000); in *Urospatha*, flowers are tetramerous and distributed uniformly throughout the spadix. Although the genera *Philodendron* and *Urospatha* belong to different cladistic groups in the Araceae family cladogram, both genera present a significant difference in their biology, as in their habits and the shape of their leaves (MAYO et al., 1997).

Lins and Oliveira (1994) and Macedo (1998) studied the embryo morphology and the foliar and ecophyisiological anatomy of *Montrichardia linifera* (Arruda) Schott respectively, aquatic plant, pioneer in várzea environments and alluvial islands former. The habit and the ecological range of this plant are quite similar to the ones found in the studied species.

It was developed an anatomic description of the subgenus Meconostigma of many species (MAYO, 1989). Many are the Araceae species with taxonomic problems similar to the *Urospatha* species, and among them are proeminent *Philodendron bipinnatifidum* and *P. selloum* (TOSTES; MACHADO, 2001; GOTTESBARGER; AMARAL Jr, 1984; MAYO, 1991), *Montrichardia linifera* and *M. arborescense* (L.) Schott (TOSTES; LINS, 1998).

In the genus *Philodendron,* the flower is staminate and usually very simple, with no trace of perianth (achlamydeous) similar to the genus *Urospatha*. Cross-section of flowers, very approximate, reveals the arrangement of the stamens around the floral axis. The number of stamens per flower varies even within a single spadix, two to six, more commonly three or four, this number not being constant (COELHO, 2000). In Urospatha, the number of stamens is around the floral axis, but it is fixed in number of four in the same spadix.

According to Coelho (2000), the number of locules in *Philodendron* varies. Even within the simple spadix, the number varies around four, five, six locules per ovary, the placentation can be basal, sub-basal and axial, which are more disseminated in the genus, while the number of locules is not defined, varying from one to many in a single locule. In the studied species, the number of locules is from one to two per ovary, the placentation is basal when in one locule and axial when it is in two, the number of ovules varies from one to two per lobe. According to French (1987), there are many placentation types in Araceae family, such as: axial, parietal, basal, apical or basal and apical and intermediate types. The ovules can be found in the following shapes: anatropous campylotropous, othotroporous or intermediate types. In the studied plants, it was verified a locule in anatropous shape.

Metcalfe and Chalk (1979) mention that aquatic plants may or may not have stomata on the leaf surface. Grayum (1990) mentions that some species of the family Araceae present stomata on both leaf surfaces; in Urospatha the tepals show this feature, being more characteristic in adaxial region. In the epidermal cells, there were observed chloroplasts, which according to Fahn (1990) are common in aquatic plants, a feature also observed in the tepals of the studied plant.

The presence of cavities and secretory channels in the Araceae family has motivated many studies and considerations (FRENCHE; TOMLINSON, 1981 a,c-d; KNECHT, 1983; FHENCH, 1987 b; MAYO, 1986 b, 1991). These structures are present in different organs, such as root, stem, leaf, seed, flower peduncle, spathe surface and spadix (MAYO et al., 1997). These characteristics can be observed in the spathe blade and in the tepals of the genus *Urospatha.*

Idioblasts are intern secretory cells which hold a variety of contents, such as tannins, terpenes, resin and mucilage, either associated or not to raphide crystals and druses appearing frequently, as a dispersed specialized cell among others less specialized. (FHAN, 1979). In Araceae, it is very common the presence of idioblasts containing calcium oxalate crystals and calcium carbonate in the shape of raphides and druses (SUNNEL; HEALEY, 1981). The crystals are related, among other functions, with the protection of plants from the attack of herbivore agents.

The great majority of the Araceaes carries calcium oxalate crystals in the shape of raphides, as observed in the following species: *Monstera deliciosa* Liebm. (AL- RAIS et al., 1971; HINCHEE, 1981), *Colocasia esculenta* (L.) Schott (SUNELL; HEALEY, 1979, 1981) and *Xanthosoma sagittifolium* (L.) Schott and Endl. (CODY; HORNER, 1983). The druses are more rare in monocotyledonous and there are few literary reports on the distribution of theses crystals in these plants; although *Acorus* L. druse crystals are quite common, specially in aerechymal tissues (GRAYUM, 1987, 1990). In certain genera, such as *Aglonomena* Schott, *Alocasia* G.Don, *Anthurium* Schott, *Colocasia* Schott, *Dieffenbachia* Schott, *Philodendron bipinatifidum, Pistia* L.,*Spathiphyllum* Schott, *Sygonium* Schott and *Zantedeschia* K. Sprengel, druses occur associated to raphides (SAKAI et al., 1972; KAUSCH; HORNER, 1981; SUNELL; HEALEY, 1981; GENUA; HILLSON, 1985; TOSTES; MACHADO, 2001). In Araceae family, it is very common to find crystals as druses and raphides associated to the parenchyma tissue, a fact registered in the studied genus.

The presence and the absence of different types of crystals in the plant can be a very important taxonomic characteristic to determine groups (METCALFE; CHALK, 1979). In reproductive organs of plants from the genus *Urospatha*, idioblast cells containing crystals occur interleaved with intercell spaces in the lacunar parenchyma, and also idioblasts containing raphides and druses may occur in structures named aerenchymas, however the idioblasts with raphides and druses are more characteristic close to the epidermis of the peduncle, the colenchyma and the spathe blade.

Eyde et al, (1967), Vogel (1963, 1990), Mayo (1986, 1989) and Chauhan, results not published yet) demonstrate the existence of secretory papillae in the surface of cells in the epidermis of the spathe, the androecium and the gynoecium of *Amorphophallus* Blume ex Decne, *Homalomena* Schott and *Philodendron* species, being this pattern quite common in the family, as verified in the genus studied. Ittenbach (1993) realized a very interesting study on the anatomy and micromorphology of some *Amorphophallus* african species.

The stem vascular bundles of the Araceae are usually from two types: leaf traits vascular bundles and cortical vascular bundles. The cortical vascular bundles can be simple, collateral, bi-collateral, amphivasal and amphicribal (MAYO et al., 1997). The peduncle studied presents simple vascular bundles randomly distributed throughout the tissue.

One of Araceae most remarkable characteristics is the presence of aerenchyma. This tissue was well documented by (ARBER, 1920; SIFTON, 1945, 1957; SCULTHORPE, 1967; KAUL, 1976; JUSTIN; ARMSTRONG, 1987; LAAN et al., 1989). The formation of intercell spaces and gaps occur with the separation of walls in some species, as in the stem of *Urospatha caudata* (TOSTES; LINS, 1998) and, in others, with the cell lysis, being this processes known, respectively, as schizogenous and lysigenous. In leaves and stems of *Montrichardia linifera*, both

processes occur simultaneously and therefore it is named schizolysigenous process. (TOSTES; LINS, 1998). The gaps, when well-developed, are denominated aerechymas, which is a parenchymal tissue specialized in gas exchanges. Aerenchyma is a tissue characteristic of aquatic plants, yet it is quite common in some epiphyte Araceae species, mainly in the stem and leaves petiole (MAYO, 1989). In Araceae, the origin, the aerechyma structure and the percentage of lacunar area vary a lot among the different taxons. Aerenchyma from schizogenous origin, as observed in the peduncle and spathe of the species studied, and more common in air organs, while organs which grown in environments with the absence of light, usually have lysigenous gaps.

The colenchyma is a very common tissue in Araceae family, being found in roots and also in the petiole, epiphyte plants peduncle with sustaining function (MAYO et al., 1997).

Gonçalves et al. (2004) studied the petiole of 79 species belonging to 47 Araceae genera, developing patterns regarding the presence or absence of colenchyma. Through this study, they grouped plants in three patterns: 1. Colenchyma absence pattern 2. Philodendroid pattern and 3. Colocasioid pattern. The species studied present lacunar parenchyma.

Conclusion

The results of this work, mainly the morpho-anatomical data, do not allow the differentiation between the two *Urospatha* species registered in the state of Amapá, because they show the same morpho-anatomical patterns for their inflorescences.

There are two problems to be considered regarding *Urospatha caudata* and *U. sargittifolia,* and other *Urospatha* sp. morphotypes. One is about the taxonomic information which surrounds this genus, complicating its identification, and the other one is nomenclatural, applied to the species of this genus, since they present a high amount of synonyms, due to the high degree of foliar morphological variability in the environment where they are found. Thus, intensive studies of this group must be developed from a systematic, ecological, genetic perspective for the perfect understanding of the group.

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